

4. Dara

Program Name: Dara.java

Input File: dara.dat

Dara has just learned about derivatives, is very confused, and needs your help with her homework, which for now only works on simple powers (no negative or fractional exponents).

She barely understands the rules of finding a derivative, which are:

- If the expression is a constant value, the derivative is zero.
- If the expression is any power in the form AX^N , where A is a positive or negative integer, and N is any positive integer, the derivative is equal to A times N , times X raised to the power of $N-1$, or $ANX^{(N-1)}$.
- The derivative of a sum of multiple operands is the sum of the derivatives of each operand.

For example, the derivative of 8 is just 0, since 8 is a constant value. The derivative of X is 1, since A is implied to be 1, and the power of X is implied to be 1. $N-1$ is zero, and so X^0 is 1, therefore $1(A)$ times $1(N)$ times $1(X^0)$ is equal to 1.

The derivative of X^5 is 5 times 1 times X^4 , or $5X^4$.

The second derivative is simply the derivative of the first derivative. For example, in the case of X^5 , if the first derivative is $5X^4$ (as shown above), then the second derivative is $20X^3$ (i.e., (5 times 4) times $X^{(4-1)}$).

Input - Several polynomial expressions, one per line. Each polynomial consists of one or more terms separated by "+" or "-", in descending order of degree, with X as the only variable. Terms with a degree of zero (i.e., " AX^0 ") will be expressed as " A ". Terms with a degree of one (i.e., " AX^1 ") will be expressed as " AX ". All numeric values (coefficients or constants) will be positive integers. There will be no fractional input values.

Output - The first and second derivative of each expression, with ":" separating the two derivative expressions. Coefficient values of 1 or -1 are not allowed, and only one sign is allowed between terms. For example, $2X + -6$ is not correct and should be expressed as $2X - 6$. Unless the overall derivative is 0, any individual terms that evaluate to 0 should not be displayed. For example, $9X^2 - 5 + 0$ should be expressed as $9X^2 - 5$. There will be no fractional output values.

Sample data:

```
8
X
X^5
5X^4
3X^3 - 5X + 8
```

Sample Output:

```
0 : 0
1 : 0
5X^4 : 20X^3
20X^3 : 60X^2
9X^2 - 5 : 18X
```